AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (Canceled)

2. (Currently Amended) ~~The transcoding method of claim 1~~ A transcoding method of performing conversion between compressed bitstreams having at least syntax elements and video elements corresponding to video data, the transcoding method comprising the steps of:

a) decoding a first bitstream compressed according to a first compression method and parsing syntax elements and video elements;

b) mapping the parsed syntax elements to syntax elements complying with a target second compression method;

c) partially reconstructing video data complying with the first compression method from the parsed video elements;

d) requantizing the video data reconstructed in the step c) according to the second compression method; and

e) coding the mapped syntax elements and the requantized video data to obtain a bitstream complying with the second compression method,

wherein the first compression method is a moving picture experts group (MPEG)-1 compression method, the second compression method is [[a]] an MPEG-4 compression method, and the step b) comprises:

b-1) converting [[a]] an MPEG-1 f_code into [[a]] an MPEG-4 f_code;

b-2) converting [[a]] an MPEG-1 macroblock (MB) type into [[a]] an MPEG-4 MB type;

b-3) converting [[a]] an MPEG-1 coded block pattern (CBP) into [[a]] an MPEG-4 CBP; and

b-4) converting [[a]] an MPEG-1 MQUANT value ~~(a quantization parameter in MPEG-1)~~ into [[a]] an MPEG-4 DQUANT value [[(a)]] corresponding to a difference of quantization ~~parameters)~~ parameters.

3. (Original) The transcoding method of claim 2, wherein the step b-1) performs the conversion according to the following equation,

$$\text{vop\_f\_code\_forward} = \max((\text{forward\_f\_code} - 1),\ 1)$$

where max(a, b) is an operator of selecting a larger value between "a" and "b".

4. (Currently Amended) The transcoding method of claim 2, wherein the step b-2) comprises the steps of:

(i) setting "nomc+coded" as [[a]] an MPEG-4 "inter" type and setting a motion vector to (0, 0);

(ii) setting "nomc+coded+q" as [[a]] an MPEG-4 "inter+q" type and setting a motion vector to (0, 0);

(iii) setting "mc+not coded" as [[a]] an MPEG-4 "inter" type, using a motion vector as it is, and setting both "cbpy" and "cbpc" to zero; and

(iv) setting the value of "code" determining "not coded" in MPEG-4 to 0 such as "cod=0" as many times as skipped MBs.

5. (Original) The transcoding method of claim 2, wherein the step b-3) comprises the steps of:

b-3-1) individually coding cbpy according to the following equation,

$$\mathrm{cbpy} = (\mathrm{cbp}\&0\mathrm{x}3\mathrm{c}) >> 2$$

where "&" indicates an AND operation performed in bit unit, "0x3c" indicates "3c" of a hexadecimal number, and ">>n" indicates an n-bit right shift operation; and

b-3-2) coding cbpc according to the following equation,

$$\mathrm{cbpc} = (\mathrm{cbp}\&0\mathrm{x}03) >> 2,$$

and

the cbpc is united with the MB type obtained in the above step b-2) and coded to comply with an mcbpc VLC table of corresponding MPEG-4 I-VOP and P-VOP.

6. (Original) The transcoding method of claim 2, wherein the step b-4) performs the conversion according to the following equation,

dquant = min (max((mquant of current MB - mquant of previous MB), -2),2).

7. (Currently Amended) The transcoding method of claim 2, wherein the step d) comprises the steps of:

estimating a Laplacian distribution of a discrete cosine transform (DCT) coefficient reconstructed from [[a]] an MPEG-1 bit stream;

determining a reconstruction level using the estimated Laplacian distribution of the DCT coefficient; and

performing quantization according to MPEG-4 using the determined reconstruction level.

8. (Currently Amended) The transcoding method of claim 2, wherein when an output y with respect to an input DCT coefficient x is expressed by $y = Q_1(x) = \left\lfloor \left\lfloor \frac{x}{\Delta} + \frac{1}{2} \right\rfloor \cdot \Delta \right\rfloor$, a quantization step size $_i$ is given by $\Delta i = \frac{Wi \cdot Q_p}{8},\ i = 0,1,2\cdots,63$ (Q_p is a quantization parameter), a decision level t_m is given by $t_m = (m - \frac{1}{2}) \cdot \Delta,\quad m \geq 1$, $x_m = \{x | x \in [t_{m,} t_{m+1}]\}$ when x belongs to a section $[t_m, t_{m+1}]$, an amplitude level λ_m of x_m is expressed by $\lambda_m = \left\lfloor \frac{x_m}{\Delta} + \frac{1}{2} \right\rfloor$, an output x' with respect to the input DCT coefficient y, which has been quantized by [[a]] an MPEG-1 quantizer having a dead zone in which a reconstruction level for x_m, that is, an inverse-quantized DCT coefficient r_m is given by $r_m = \lfloor \lambda_m \cdot \Delta \rfloor$, is expressed by

$$x' = Q_2(y) = \begin{cases} \left\lfloor \left\lfloor \frac{y}{\Delta'} \right\rfloor \cdot \Delta' + \frac{\Delta'}{2} \right\rfloor & \text{if } Q_p \text{ is odd} \\ \left\lfloor \left\lfloor \frac{y}{\Delta'} \right\rfloor \cdot \Delta' + \frac{\Delta'}{2} \right\rfloor - 1 & \text{if } Q_p \text{ is even} \end{cases}$$

, a quantization step size is given by $\Delta' = 2Q_p$, a decision level t_n is given by $t'_n = n \cdot \Delta', \quad n \geq 1$, $y_n = \{y | y \in [t'_n, t'_{n+1}]\}$ when the output y belongs to a section $[t\_n, t\_{n+1}]$, and an amplitude level of y_n, that is, an inverse-quantized DCT coefficient λ'_n is requantized by [[a]] an MPEG-4 quantizer having a dead zone defined as $\lambda'_n = \left\lfloor \frac{y_n}{\Delta'} \right\rfloor$ and is converted into [[a]] an MPEG-4 DCT coefficient, the step d) comprises the steps of:

d-1) defining subscript values allowing the decision level to belong to a section $[t_m, t_{m+1}]$ as a set $P = \{p | t'_p \in [t_m, t_{m+1}]\}$;

d-2) defining candidates of the subscript values of the decision level as a set

$K = P \cup \{\min\{P\} - 1\}$

where the symbol U indicates a union and an operator min{A} indicates a minimum value among the members of a set A; and

d-3) selecting a member satisfying a cost function from among the candidate subscript values as a final subscript value, the cost function being expressed by

$$k = \arg \min_{k \in K} |C_m - r'_k| \quad where \quad C_m = \frac{\int_{t_m}^{t_{m+1}} x \cdot p(x)dx}{\int_{t_m}^{t_{m+1}} p(x)dx}$$

where C_m is an optimum reconstruction level in the section $[t_m, t_{m+1}]$ used by a Lloyd- Max quantizer in view of mean square error, and $p(x)$ is a Laplacian distribution function.

9. (Original) The transcoding method of claim 8, wherein in the step d-3), C_m is obtained by analyzing the statistical characteristic of $p(x)$.

10. (Original) The transcoding method of claim 9, wherein when it is assumed that AC DCT coefficients comply with a Laplacian distribution expressed by

$$p(x) = \frac{\lambda}{2} \cdot e^{-\lambda|x|},$$

a step of determining the value of λ determining the statistical characteristic of $p(x)$ comprises the steps of:

d-3-1) calculating an average of a random variable $|x|$ according to

$$E(|x|) = \int_{-\infty}^{\infty} |x| \cdot p(x)dx = \int_{-\infty}^{\infty} |x| \cdot \frac{\lambda}{2} \cdot e^{-\lambda|x|}dx = \frac{1}{\lambda}$$; and

d-3-2) determining λ according to $\lambda = \frac{1}{E(|x|)}$.

11. (Original) The transcoding method of claim 10, wherein the step d-3-2) comprises the steps of:

d-3-2-1) approximating the value of $E(|x|)$ according to

$$E(|x|) \cong E(|y|) + E(|z|)_{\frac{\Delta}{2}}$$

where $E(|z|)_{\frac{\Delta}{2}} = \int_{-\frac{\Delta}{2}}^{\frac{\Delta}{2}} |z| \cdot p(z)dz$, and $p(z) = \frac{\lambda'}{2} \cdot e^{-\lambda'|z|}$ *where* $\lambda' = \frac{1}{E(|y|)}$;

d-3-2-2) calculating $E(|z|)_{\frac{\Delta}{2}}$ according to

$$E(|z|)_{\frac{\Delta}{2}} = 2 \cdot \int_0^{\frac{\lambda}{2}} z \cdot \frac{\lambda'}{2} \cdot e^{-\lambda'/z} dz = \frac{1}{\lambda'} - e^{-\lambda'\Delta/2}\left(\frac{1}{\lambda'} + \frac{\Delta}{2}\right)$$

; and

d-3-2-3) estimating the value of λ according to

$$\lambda = \frac{1}{E(|x|)} \cong \frac{1}{E(|y|) + E(|z|)_{\frac{\Delta}{2}}} = \frac{\lambda'}{2 - e^{-\lambda'\Delta/2}(1 + \frac{\Delta}{2}\lambda')}.$$

12. (Original) A requantizing method in which an output y with respect to an input DCT coefficient x is expressed by $y = Q_1(x) = \left\lfloor \left\lfloor \frac{x}{\Delta} + \frac{1}{2} \right\rfloor \cdot \Delta \right\rfloor$, a quantization step size Δ_i is given by $\Delta i = \frac{Wi \cdot Q_p}{8}$, $i = 0,1,2\cdots,63$ (Q_p is a quantization parameter), a decision level t_m is given by $t_m = (m - \frac{1}{2}) \cdot \Delta$, $m \geq 1$, $x_m = \{x | x \in [t_m, t_{m+1}]\}$ when x belongs to a section $[t_m, t_{m+1}]$, an amplitude level λ_m of x_m is expressed by $\lambda_m = \left\lfloor \frac{x_m}{\Delta} + \frac{1}{2} \right\rfloor$, an output x' with respect to the input DCT coefficient y, which has been quantized by a MPEG-1 quantizer having a dead zone in which a reconstruction level for x_m, that is, an inverse-quantized DCT coefficient r_m is given by $r_m = \lfloor \lambda_m \cdot \Delta \rfloor$, is expressed by

$$x' = Q_2(y) = \begin{cases} \left\lfloor \left\lfloor \frac{y}{\Delta'} \right\rfloor \cdot \Delta' + \frac{\Delta'}{2} \right\rfloor & \text{if } Q_p \text{ is odd} \\ \left\lfloor \left\lfloor \frac{y}{\Delta'} \right\rfloor \cdot \Delta' + \frac{\Delta'}{2} \right\rfloor - 1 & \text{if } Q_p \text{ is even} \end{cases}$$

, a quantization step size Δ' is given by $\Delta' = 2Q_p$, a decision level t'_n is given by $t'_n = n \cdot \Delta', \quad n \geq 1$, $y_n = \{y | y \in [t'_n, t'_{n+1}]\}$ when the output y belongs to a section $[t\_{n}, t\_{n+1}]$, and an amplitude level of y_n, that is, an inverse-quantized DCT coefficient λ'_n is requantized by a MPEG-4 quantizer having a dead zone defined as $\lambda'_n = \left\lfloor \frac{y_n}{\Delta'} \right\rfloor$ and is converted into a MPEG-4 DCT coefficient, the requantizing method comprising the steps of:

d-1) defining subscript values allowing the decision level to belong to a section $[t_m, t_{m+1}]$ as a set $P = \{p | t'_p \in [t_m, t_{m+1}]\}$;

d-2) defining candidates of the subscript values of the decision level as a set $K = P \cup \{\min\{P\} - 1\}$ where the symbol U indicates a union and an operator min{A} indicates a minimum value among the members of a set A; and

d-3) selecting a member satisfying a cost function from among the candidate subscript values as a final subscript value, the cost function being expressed by

$$k = \arg \min_{k \in K} |C_m - r'_k| \quad where \quad C_m = \frac{\int_{t_m}^{t_m+1} x \cdot p(x) dx}{\int_{t_m}^{t_m+1} p(x) dx}$$

where C_m is an optimum reconstruction level in the section $[t_m, t_{m+1}]$ used by a Lloyd-Max quantizer in view of mean square error, and $p(x)$ is a Laplacian distribution function.

13. (Original) The requantizing method of claim 12, wherein in the step d-3), the balance point C_m is obtained by analyzing the statistical characteristic of $p(x)$.

14. (Original) The requantizing method of claim 13, wherein when it is assumed that AC DCT coefficients comply with a Laplacian distribution expressed by

$$p(x) = \frac{\lambda}{2} \cdot e^{-\lambda|x|},$$

a step of determining the value of □ determining the statistical characteristic of $p(x)$ comprises the steps of:

d-3-1) calculating an average of a random variable $|x|$ according to

$$E(|x|) = \int_{-\infty}^{\infty} |x| \cdot p(x)dx = \int_{-\infty}^{\infty} |x| \cdot \frac{\lambda}{2} \cdot e^{-\lambda|x|}dx = \frac{1}{\lambda}$$; and

d-3-2) determining λ according to $\lambda = \dfrac{1}{E(|x|)}$.

15. (Original) The transcoding method of claim 14, wherein the step d-3-2) comprises the steps of:

d-3-2-1) approximating the value of $E(|x|)$ according to

$$E(|x|) \cong E(|y|) + E(|z|)_{\frac{\Delta}{2}}$$

where $E(|z|)_{\frac{\Delta}{2}} = \int_{-\frac{\Delta}{2}}^{\frac{\Delta}{2}} |z| \cdot p(z)dz$, and $p(z) = \frac{\lambda'}{2} \cdot e^{-\lambda'|z|}$ *where* $\lambda' = \frac{1}{E(|y|)}$;

d-3-2-2) calculating $E(|z|)_{\frac{\Delta}{2}}$ according to

$$E(|z|)_{\frac{\Delta}{2}} = 2 \cdot \int_{0}^{\frac{\lambda}{2}} z \cdot \frac{\lambda'}{2} \cdot e^{-\lambda' z} dz = \frac{1}{\lambda'} - e^{-\lambda'\Delta/2}\left(\frac{1}{\lambda'} + \frac{\Delta}{2}\right)$$

; and

d-3-2-3) estimating the value of λ according to

$$\lambda = \frac{1}{E(|x|)} \cong \frac{1}{E(|y|) + E(|z|)_{\frac{\Delta}{2}}} = \frac{\lambda'}{2 - e^{-\lambda'\Delta/2}\left(1 + \frac{\Delta}{2}\lambda'\right)}.$$

16. (Currently Amended) A transcoding apparatus of performing conversion between compressed bitstreams having at least syntax elements and video elements corresponding to video data, the transcoding apparatus comprising:

a decoder for reconstructing syntax elements and video elements from a first bitstream complying with a ~~first~~ moving picture experts group (MPEG)-1 compression method;

an inverse quantizer for inverse-quantizing the video elements provided from the decoder according to the ~~first~~ moving picture experts group (MPEG)-1 compression method to reconstruct video data;

a quantizer for requantizing the video data according to ~~a second~~ an MPEG-4 compression method;

a syntax generator for mapping the syntax elements provided from the decoder to syntax elements complying with the ~~second~~ MPEG-4 compression method; and

an encoder for encoding the requantized video data ~~(video elements complying with the second compression method)~~ provided from the quantizer and the syntax elements provided from the syntax generator according to the ~~second~~ MPEG-4 compression method, thereby outputting a second bitstream,

wherein the syntax generator converts an MPEG-1 f_code into an MPEG-4 f_code, converts an MPEG-1 macroblock (MB) type into an MPEG-4 MB type, converts an MPEG-1 coded block pattern (CBP) into an MPEG-4 CBP, and converts an MPEG-1 MQUANT value into an MPEG-4 DQUANT value corresponding to a difference of quantization parameters.

17. (Canceled)

18. (New) The transcoding apparatus of claim 16, wherein the first compression method is a moving picture experts group (MPEG)-1 compression method, the second compression method is an MPEG-4 compression method, and the syntax generator converts an MPEG-1 f_code into an MPEG-4 f_code, an MPEG-1 macroblock (MB) type into an MPEG-4 MB type; an MPEG-1 coded block pattern (CBP) into an MPEG-4 CBP; and an MPEG-1 MQUANT value into a MPEG-4 DQUANT value.

19. (New) The transcoding apparatus of claim 18, wherein the syntax generator converts the MPEG-1 f_code into the MPEG-4 f_code according to the following equation,

$$\begin{aligned}&vop\_f\_code\_forward\\&= \max((forward\_f\_code - 1),\ 1)\end{aligned}$$

where max(a, b) is an operator of selecting a larger value between "a" and "b".

20. (New) The transcoding apparatus of claim 18, wherein the syntax generator converts the MPEG-1 macroblock (MB) type into the MPEG-4 MB type by:

(i) setting "nomc+coded" as a MPEG-4 "inter" type and setting a motion vector to (0, 0);

(ii) setting "nomc+coded+q" as a MPEG-4 "inter+q" type and setting a motion vector to (0, 0);

(iii) setting "mc+not coded" as a MPEG-4 "inter" type, using a motion vector as it is, and setting both "cbpy" and "cbpc" to zero; and

(iv) setting the value of "code" determining "not coded" in MPEG-4 to 0 such as "cod=0" as many times as skipped MBs.

21. (New) The transcoding apparatus of claim 18, wherein the syntax generator converts the MPEG-1 coded block pattern (CBP) into the MPEG-4 CBP by individually coding cbpy according to the following equation,

$$cbpy = (cbp\&0x3c) >> 2$$

where "&" indicates an AND operation performed in bit unit, "0x3c" indicates "3c" of a hexadecimal number, and ">>n" indicates an n-bit right shift operation; and

coding cbpc according to the following equation,

$$\text{cbpc} = (\text{cbp}\&0\text{x}03) >> 2,$$

and

the cbpc is united with the MB type and coded to comply with an mcbpc VLC table of corresponding MPEG-4 I-VOP and P-VOP.

22. (New) The transcoding apparatus of claim 18, wherein the syntax generator converts the MPEG-1 MQUANT value into the MPEG-4 DQUANT value according to the following equation,

dquant = min (max((mquant of current MB - mquant of previous MB), -2),2).

23. (New) The transcoding apparatus of claim 18, wherein the quantizer requantizes the video data by estimating a Laplacian distribution of a discrete cosine transform (DCT) coefficient reconstructed from a MPEG-1 bit stream, determining a reconstruction level using the estimated Laplacian distribution of the DCT coefficient, and performing quantization according to MPEG-4 using the determined reconstruction level.

24. (New) The transcoding apparatus of claim 18, wherein when an output y with respect to an input DCT coefficient x is expressed by $y = Q_1(x) = \left\lfloor \left\lfloor \frac{x}{\Delta} + \frac{1}{2} \right\rfloor \cdot \Delta \right\rfloor$, a quantization step size $_i$ is given by $\Delta i = \frac{Wi \cdot Q_p}{8},\ i = 0,1,2\cdots,63$ (Q_p is a quantization

parameter), a decision level t_m is given by $t_m = (m - \frac{1}{2}) \cdot \Delta, \quad m \geq 1$, $x_m = \{x | x \in [t_{m,} t_{m+1}]\}$ when x belongs to a section $[t_m, t_{m+1}]$, an amplitude level λ_m of x_m is expressed by $\lambda_m = \left\lfloor \frac{x_m}{\Delta} + \frac{1}{2} \right\rfloor$, an output x' with respect to the input DCT coefficient y, which has been quantized by a MPEG-1 quantizer having a dead zone in which a reconstruction level for x_m, that is, an inverse-quantized DCT coefficient r_m is given by $r_m = \lfloor \lambda_m \cdot \Delta \rfloor$, is expressed by

$$x' = Q_2(y) = \begin{cases} \left\lfloor \left\lfloor \frac{y}{\Delta'} \right\rfloor \cdot \Delta' + \frac{\Delta'}{2} \right\rfloor & \text{if } Q_p \text{ is odd} \\ \left\lfloor \left\lfloor \frac{y}{\Delta'} \right\rfloor \cdot \Delta' + \frac{\Delta'}{2} \right\rfloor - 1 & \text{if } Q_p \text{ is even} \end{cases},$$

a quantization step size is given by $\Delta' = 2Q_p$, a decision level t_n is given by $t'_n = n \cdot \Delta', \quad n \geq 1$, $y_n = \{y | y \in [t'_n, t'_{n+1}]\}$ when the output y belongs to a section $[t\_n, t\_{n+1}]$, and an amplitude level of y_n, that is, an inverse-quantized DCT coefficient λ'_n is requantized by the quantizer which has a dead zone defined as $\lambda'_n = \left\lfloor \frac{y_n}{\Delta'} \right\rfloor$ and is converted into a MPEG-4 DCT coefficient, the quantizer requantizes the video data by:

defining subscript values allowing the decision level to belong to a section $[t_m, t_{m+1}]$ as a set $P = \{p | t'_p \in [t_m, t_{m+1}]\}$;

defining candidates of the subscript values of the decision level as a set

$K = P \cup \{\min\{P\} - 1\}$

where the symbol U indicates a union and an operator min{A} indicates a minimum value among the members of a set A; and

selecting a member satisfying a cost function from among the candidate subscript values as a final subscript value, the cost function being expressed by

$$k = \arg \min_{k \in K} |C_m - r'_k| \quad where \quad C_m = \frac{\int_{t_m}^{t_m+1} x \cdot p(x)dx}{\int_{t_m}^{t_m+1} p(x)dx}$$

where C_m is an optimum reconstruction level in the section $[t_m, t_{m+1}]$ used by a Lloyd- Max quantizer in view of mean square error, and $p(x)$ is a Laplacian distribution function.

25. (New) The transcoding apparatus of claim 24, wherein C_m is obtained by analyzing the statistical characteristic of $p(x)$.

26. (New) The transcoding apparatus of claim 25, wherein when it is assumed that AC DCT coefficients comply with a Laplacian distribution expressed by

$$p(x) = \frac{\lambda}{2} \cdot e^{-\lambda|x|},$$

the value of λ determining the statistical characteristic of $p(x)$ is determined by calculating an average of a random variable $|x|$ according to

$$E(|x|) = \int_{-\infty}^{\infty} |x| \cdot p(x)dx = \int_{-\infty}^{\infty} |x| \cdot \frac{\lambda}{2} \cdot e^{-\lambda|x|}dx = \frac{1}{\lambda}$$, and

determining λ according to $\lambda = \frac{1}{E(|x|)}$.

27. (New) The transcoding method of claim 26, wherein determining λ according to $\lambda = \frac{1}{E(|x|)}$ comprises:

approximating the value of $E(|x|)$ according to

$$E(|x|) \cong E(|y|) + E(|z|)_{\frac{\Delta}{2}}$$

where $E(|z|)_{\frac{\Delta}{2}} = \int_{-\frac{\Delta}{2}}^{\frac{\Delta}{2}} |z| \cdot p(z)dz$, and $p(z) = \frac{\lambda'}{2} \cdot e^{-\lambda'|z|}$ *where* $\lambda' = \frac{1}{E(|y|)}$;

calculating $E(|z|)_{\frac{\Delta}{2}}$ according to

$$E(|z|)_{\frac{\Delta}{2}} = 2 \cdot \int_0^{\frac{\lambda}{2}} z \cdot \frac{\lambda'}{2} \cdot e^{-\lambda'/z} dz = \frac{1}{\lambda'} - e^{-\lambda'\Delta/2}\left(\frac{1}{\lambda'} + \frac{\Delta}{2}\right)$$; and

estimating the value of λ according to

$$\lambda = \frac{1}{E(|x|)} \cong \frac{1}{E(|y|) + E(|z|)_{\frac{\Delta}{2}}} = \frac{\lambda'}{2 - e^{-\lambda'\Delta/2}(1 + \frac{\Delta}{2}\lambda')}.$$